PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-355494

(43)Date of publication of application : 26.12.2001

(51)Int.Cl.

F02D 41/12
B60K 41/00
B60K 41/20
B60T 17/00
F02D 9/02
F02D 13/02
F02D 29/00
F02D 29/02
F02D 41/06
F02D 41/08
F02D 43/00
F02D 45/00
F02P 5/15

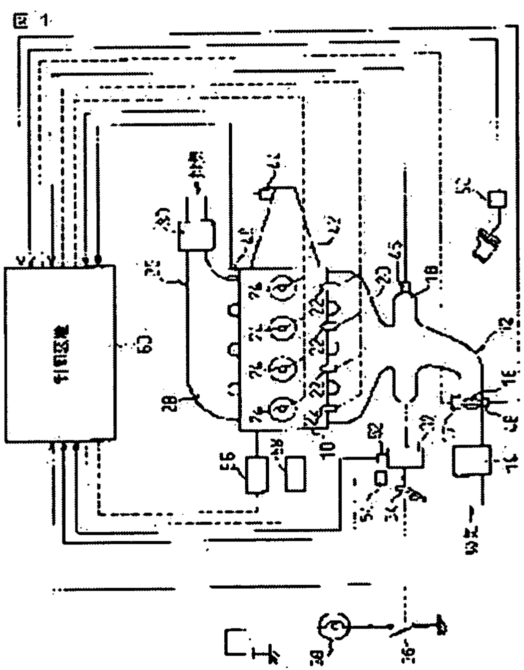
(21)Application number : 2000-184587

(22)Date of filing : 15.06.2000

(71)Applicant : TOYOTA MOTOR CORP

(72)Inventor : KANAMARU MASANOBU

(54) CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a control device capable of realizing a control in which an equilibrium between an enhancement of a catalyst warming property and an insurance of brake performance is realized.

SOLUTION: The control device is loaded on a vehicle provided with a brake booster making a suction negative pressure of internal combustion engine as a servo source and carries out a late angle control of an ignition timing of the internal combustion engine under a predetermined operation state. The control device is provided with a booster state monitor means for monitoring a brake booster condition during carrying out the ignition timing late angle control and a negative pressure recover control means for solving a lack of the negative pressure by controlling a control parameter for varying an operation state of the internal combustion engine when the lack of negative pressure is detected by the booster condition monitor means. When a braking force is determined and it is judged that the braking force is lacked, the lack of the braking force is solved by increasing a suction negative pressure

of the internal combustion engine by varying at least one of the suctioned air amount of the internal combustion engine or the ignition timing.

LEGAL STATUS

[Date of request for examination]	20.05.2003
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

Japanese Publication number : 2001-355494 A

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] While being carried in the car equipped with the brake booster which makes an internal combustion engine's inhalation negative pressure the source of redoubling A booster house keeping means is a control device and supervise the condition of a brake booster during ignition timing lag control activation to perform lag control of an internal combustion engine's ignition timing when it is in predetermined operational status, An internal combustion engine's control unit possessing the negative pressure recovery control means which controls the control parameter to which an internal combustion engine's operational status is changed, and cancels lack of negative pressure when lack of negative pressure is detected by said booster house keeping means.

[Claim 2] Said negative pressure recovery control means is a control unit of an internal combustion engine according to claim 1 which is what controls at least one of an internal combustion engine's inhalation air content or ignition timing.

[Claim 3] Said negative pressure recovery control means is a control unit of an internal combustion engine according to claim 2 which computes the throttle opening which attains demand negative pressure, presumes an inhalation air content from this throttle opening, computes the amount of ignition timing lags from torque required to maintain this inhalation air content and idle rotation, and controls an inhalation air content and ignition timing.

[Claim 4] The control unit of an internal combustion engine according to claim 3 with which this demand negative pressure is determined according to booster operating time.

[Claim 5] Said negative pressure recovery control means is a control unit of an internal combustion engine according to claim 2 which stops ignition timing lag control, computes the throttle opening which can realize torque required to maintain idle rotation, and controls an inhalation air content and ignition timing when booster operating time turns into beyond predetermined time.

[Claim 6] Said negative pressure recovery control means is a control unit of an internal combustion engine according to claim 1 which is what stops actuation of an internal combustion engine's electric load temporarily.

[Claim 7] Said negative pressure recovery control means is a control unit of an internal combustion engine according to claim 6 which controls at least one of an internal combustion engine's inhalation air content or ignition timing as the further negative

pressure recovery control when lack of negative pressure is not canceled by halt of actuation of electric load, either.

[Claim 8] Said negative pressure recovery control means is a control unit of an internal combustion engine according to claim 1 which is that to which only the specified quantity carries out the tooth lead angle of the inhalation-of-air valve timing when an internal combustion engine's inhalation-of-air valve timing is set as the maximum lag location.

[Claim 9] Said negative pressure recovery control means is a control unit of an internal combustion engine according to claim 8 which controls at least one of an internal combustion engine's inhalation air content or ignition timing as the further negative pressure recovery control when lack of negative pressure is not canceled by the tooth lead angle of inhalation-of-air valve timing, either.

[Claim 10] Said negative pressure recovery control means is a control unit of an internal combustion engine according to claim 1 which is what shifts this change gear to a low-speed stage side when it has a change gear in the drive system of a car.

[Claim 11] Said negative pressure recovery control means is a control unit of an internal combustion engine according to claim 10 which controls at least one of an internal combustion engine's inhalation air content or ignition timing as the further negative pressure recovery control when lack of negative pressure is not canceled by the shift by the side of the low-speed stage of a change gear, either.

[Claim 12] Said further negative pressure recovery control is the control unit of an internal combustion engine given in any 1 term of claim 7 and claim 9 which are what computes the throttle opening which attains demand negative pressure, presumes an inhalation air content from this throttle opening, computes the amount of ignition timing lags from torque required to maintain this inhalation air content and idle rotation, and controls an inhalation air content and ignition timing, or claim 11.

[Claim 13] Said booster house keeping means is what also supervises the travel and the actuation rate of a booster. Said negative pressure recovery control means Compute demand negative pressure from this travel and this actuation rate, and the throttle opening which attains this demand negative pressure is computed. The control unit of an internal combustion engine according to claim 2 which presumes an inhalation air content from this throttle opening, computes the amount of ignition timing lags from torque required to maintain this inhalation air content and idle rotation, and controls an inhalation air content and ignition timing.

[Claim 14] A target damping force calculation means to be an internal combustion engine's control device carried in the car equipped with the brake booster which makes an internal combustion engine's inhalation negative pressure the source of redoubling, and to compute target damping force from the actuation situation of a brake booster, When judged with damping force being insufficient with a damping force judging means to judge whether damping force is insufficient based on the target damping force computed by said target damping force calculation means, and said damping force judging means An internal combustion engine's control unit possessing the damping force recovery control means

which cancels lack of damping force by changing at least one of an internal combustion engine's inhalation air content or ignition timing, and increasing an internal combustion engine's inhalation negative pressure.

[Claim 15] Said damping force judging means is a control unit of an internal combustion engine according to claim 14 which is what judges lack of damping force based on the deflection of the target damping force computed by said target damping force calculation means, the realizable damping force presumed from the negative pressure of a brake booster, and **.

[Claim 16] Said damping force judging means is a control unit of an internal combustion engine according to claim 14 which is what judges lack of damping force based on the deflection of the target damping force computed by said target damping force calculation means, the real damping force presumed from the change situation of the vehicle speed, and **.

[Claim 17] Said damping force recovery control means is a control unit of an internal combustion engine according to claim 15 or 16 which is what computes demand negative pressure from said deflection, computes the throttle opening which attains this demand negative pressure, presumes an inhalation air content from this throttle opening, computes the amount of ignition timing lags from torque required to maintain this inhalation air content and idle rotation, and controls an inhalation air content and ignition timing.

[Claim 18] Said damping force recovery control means is a control unit of an internal combustion engine according to claim 15 or 16 which is what computes the amount of ignition timing lags from said deflection, and controls ignition timing.

[Claim 19] The control unit of an internal combustion engine according to claim 15 with which said realizable damping force is presumed also in consideration of driving torque in addition to the negative pressure of a brake booster.

[Claim 20] The control unit of an internal combustion engine given in any 1 term from claim 1 to claim 19 which possesses further an exception-processing means to return control of an inhalation air content and/or ignition timing to the usual control when abnormalities are detected while detecting the abnormalities of a sensor system.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to an internal combustion engine's control device carried in the car which equipped the detail with the brake booster which makes an internal combustion engine's inhalation negative pressure the source of redoubling more about an internal combustion engine's control device.

[0002]

[Description of the Prior Art] The ignition timing lag control for raising the warming-up

nature of the catalyst prepared in the flueway that exhaust gas should be purified in an internal combustion engine in recent years is being introduced. When this carries out the lag of the ignition timing, it is based on a burn-out stage and the rate of combustion being overdue, and exhaust loss increasing, consequently hot exhaust gas being supplied to a catalyst, and early warming up of a catalyst being realized. And since the lag of ignition timing is accompanied by the fall of an engine torque, control which makes an inhalation air content increase generally at the time of activation of this ignition timing lag control in order to prevent the fall of an engine torque is performed by coincidence (for example, refer to JP,11-107822,A).

[0003]

[Problem(s) to be Solved by the Invention] On the other hand, in the car, in order to make the operating physical force of a brake pedal light at the time of braking, the brake booster is adopted widely. Generally the brake booster makes engine inhalation negative pressure the source of redoubling. Therefore, when an inhalation air content is made to increase corresponding to the ignition timing lag control for catalyst warming up, in order to open a throttle valve and for the absolute value of inlet-pipe negative pressure to fall (an atmospheric pressure is approached), brake performance may fall.

[0004] This invention is made in view of the trouble mentioned above, and the purpose is in offering an internal combustion engine's control unit which can realize control which aimed at balance between improvement in catalyst warming-up nature, and reservation of brake performance.

[0005]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, while being carried in the car equipped with the brake booster which makes an internal combustion engine's inhalation negative pressure the source of redoubling according to the 1st mode of this invention A booster house keeping means is a control device and supervise the condition of a brake booster during ignition timing lag control activation to perform lag control of an internal combustion engine's ignition timing when it is in predetermined operational status, When lack of negative pressure is detected by said booster house keeping means, an internal combustion engine's control unit possessing the negative pressure recovery control means which controls the control parameter to which an internal combustion engine's operational status is changed, and cancels lack of negative pressure is offered.

[0006] moreover, the 2nd voice of this invention -- if it depends like -- said 1st voice -- in the equipment applied like, said negative pressure recovery control means controls at least one of an internal combustion engine's inhalation air content or ignition timing.

[0007] moreover, the 3rd voice of this invention -- if it depends like -- said 2nd voice -- in the equipment applied like, said negative pressure recovery control means computes the throttle opening which attains demand negative pressure, presumes an inhalation air content from this throttle opening, computes the amount of ignition timing lags from torque required to maintain this inhalation air content and idle rotation, and controls an

inhalation air content and ignition timing.

[0008] Moreover, according to the 4th mode of this invention, in the equipment concerning said 3rd mode, this demand negative pressure is determined according to booster operating time.

[0009] Moreover, according to the 5th mode of this invention, in the equipment concerning said 2nd mode, when booster operating time turns into beyond predetermined time, said negative pressure recovery control means stops ignition timing lag control, computes the throttle opening which can realize torque required to maintain idle rotation, and controls an inhalation air content and ignition timing.

[0010] moreover, the 6th voice of this invention -- if it depends like -- said 1st voice -- in the equipment applied like, said negative pressure recovery control means stops actuation of an internal combustion engine's electric load temporarily.

[0011] moreover, the 7th voice of this invention -- if it depends like -- said 6th voice -- in the equipment applied like, said negative pressure recovery control means controls at least one of an internal combustion engine's inhalation air content or ignition timing as the further negative pressure recovery control, when lack of negative pressure is not canceled by halt of actuation of electric load, either.

[0012] moreover, the 8th voice of this invention -- if it depends like -- said 1st voice -- in the equipment applied like, when, as for said negative pressure recovery control means, an internal combustion engine's inhalation-of-air valve timing is set as the maximum lag location, only the specified quantity carries out the tooth lead angle of the inhalation-of-air valve timing.

[0013] moreover, the 9th voice of this invention -- if it depends like -- said 8th voice -- in the equipment applied like, said negative pressure recovery control means controls at least one of an internal combustion engine's inhalation air content or ignition timing as the further negative pressure recovery control, when lack of negative pressure is not canceled by the tooth lead angle of inhalation-of-air valve timing, either.

[0014] Moreover, according to the 10th mode of this invention, in the equipment concerning said 1st mode, said negative pressure recovery control means shifts this change gear to a low-speed stage side, when it has a change gear in the drive system of a car.

[0015] moreover, the 11th voice of this invention -- if it depends like -- said 10th voice -- in the equipment applied like, said negative pressure recovery control means controls at least one of an internal combustion engine's inhalation air content or ignition timing as the further negative pressure recovery control, when lack of negative pressure is not canceled by the shift by the side of the low-speed stage of a change gear, either.

[0016] moreover, the 12th voice of this invention -- if it depends like -- said 7th, 9th, or 11th voice -- in the equipment applied like, said further negative-pressure recovery control computes the throttle opening which attains demand negative pressure, presumes an inhalation air content from this throttle opening, computes the amount of ignition timing lags from torque required to maintain this inhalation air content and idle rotation, and controls an inhalation air content and ignition timing.

[0017] In the equipment which is applied to said 2nd mode according to the 13th mode of this invention moreover, said booster house keeping means It is what also supervises the travel and the actuation rate of a booster. Said negative pressure recovery control means Compute demand negative pressure from this travel and this actuation rate, and the throttle opening which attains this demand negative pressure is computed. An inhalation air content is presumed from this throttle opening, the amount of ignition timing lags is computed from torque required to maintain this inhalation air content and idle rotation, and an inhalation air content and ignition timing are controlled.
[0018] Moreover, according to the 14th mode of this invention, it is an internal combustion engine's control unit carried in the car equipped with the brake booster which makes an internal combustion engine's inhalation negative pressure the source of redoubling. A target damping force calculation means to compute target damping force from the actuation situation of a brake booster, When judged with damping force being insufficient with a damping force judging means to judge whether damping force is insufficient based on the target damping force computed by said target damping force calculation means, and said damping force judging means An internal combustion engine's control unit possessing the damping force recovery control means which cancels lack of damping force by changing at least one of an internal combustion engine's inhalation air content or ignition timing, and increasing an internal combustion engine's inhalation negative pressure is offered.
[0019] moreover, the 15th voice of this invention -- if it depends like -- said 14th voice -- in the equipment applied like, said damping force judging means judges lack of damping force based on the deflection of the target damping force computed by said target damping force calculation means, the realizable damping force presumed from the negative pressure of a brake booster, and **.
[0020] moreover, the 16th voice of this invention -- if it depends like -- said 14th voice -- in the equipment applied like, said damping force judging means judges lack of damping force based on the deflection of the target damping force computed by said target damping force calculation means, the real damping force presumed from the change situation of the vehicle speed, and **.
[0021] In the equipment which is applied to said 15th or 16th mode according to the 17th mode of this invention moreover, said damping force recovery control means Compute demand negative pressure from said deflection, and compute the throttle opening which attains this demand negative pressure, and presume an inhalation air content from this throttle opening, and the amount of ignition timing lags is computed from torque required to maintain this inhalation air content and idle rotation. An inhalation air content and ignition timing are controlled.
[0022] Moreover, according to the 18th mode of this invention, in the equipment concerning said 15th or 16th mode, said damping force recovery control means computes the amount of ignition timing lags from said deflection, and controls ignition timing.
[0023] Moreover, according to the 19th mode of this invention, in addition to the negative pressure of a brake booster, in the equipment concerning said 15th mode, said realizable

damping force is presumed also in consideration of driving torque.
[0024] moreover, the 20th voice of this invention -- if it depends like -- said each voice -- in the equipment applied like, while detecting the abnormalities of a sensor system, when abnormalities are detected, an exception-processing means to return control of an inhalation air content and/or ignition timing to the usual control possesses further.
[0025]
[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained with reference to an accompanying drawing.
[0026] Drawing 1 is the internal combustion engine (engine) whole schematic diagram equipped with the control device concerning this invention. An engine 10 is a serial Taki cylinder 4 stroke cycle reciprocating gasoline engine for car loading. The inhalation-of-air path 12 is connected to the suction port of an engine 10, and the air cleaner 14, the throttle valve 16, the surge tank 18, and the inlet-manifold 20 grade are prepared in the inhalation-of-air path 12. In addition, the throttle valve 16 in this operation gestalt is the so-called electronic throttle, and it is made to drive it by the throttle motor 17, without being combined with the accelerator pedal of a driver's seat directly mechanically.
[0027] The air (open air) of the exterior of an engine 10 passes each part 14, 16, 18, and 20 of the inhalation-of-air path 12 in order towards the combustion chamber in a cylinder. The injector 22 which injects a fuel towards each suction port is attached in the inlet manifold 20. In order to light the gaseous mixture in a cylinder, the ignition plug 24 is attached in the cylinder head. The gaseous mixture which burned is discharged in atmospheric air from an exhaust air port through an exhaust manifold 28 and the flueway 26 equipped with the catalytic-converter 30 grade.
[0028] The brake booster 32 is equipment for mitigating the force required operating a brake pedal 34, and has obtained the source of redoubling from the inhalation negative pressure in a surge tank 18. In addition, when a brake pedal 34 is operated, the brake switch (stop switch) 36 is made to close, and a stop lamp 38 lights up.
[0029] Various kinds of sensors are attached in the car. Among those, the sensor relevant to each operation gestalt is explained. First, in order to detect the rotational speed (rotational frequency) of a crankshaft, the crank angle sensor 40 made to generate the pulse for rotational-speed detection is formed. Moreover, the speed sensor 44 which generates a number proportional to the rotational speed SPD, i.e., the vehicle speed, of an output shaft of a change gear (transmission) 42 of output pulses in per unit time amount is attached.
[0030] The intake-pressure sensor 46 for detecting the pressure of the interior is attached in the surge tank 18. At the inhalation-of-air path 12, the throttle opening sensor 48 which detects the rotation include angle of the shaft, and the accelerator opening sensor 50 which detects the amount of accelerator treading in (accelerator opening) are formed near the throttle valve 16.
[0031] Moreover, the brake booster ** sensor 52 which detects the pressure of the part which is open for free passage to a surge tank 18 is attached in the brake booster 32.

Moreover, it is premised on the brake sensor 54 which detects the amount of brake treading in being formed near the brake pedal 34 with a part of operation gestalten mentioned later.

[0032] Moreover, a part of operation gestalten mentioned later are premised on the car with which the air-conditioner (air conditioner) 56 as an internal combustion engine's electric load was carried. The air-conditioner is equipped with the compressor for compressing a refrigerant gas, and the compressor is connected through an engine crankshaft pulley and an engine belt. Therefore, if an air-conditioner is turned ON, an engine load will increase. Moreover, it is premised on the engine with which the adjustable valve timing (VVT) device 58 for changing the closing motion timing of an inlet valve was established with another operation gestalt. It is premised on a change gear (transmission) 42 being an electronics control-type automatic transmission with the operation gestalt of further others.

[0033] A control unit 60 is a microcomputer system which performs fuel-injection control, ignition timing control, etc., inputs the signal from various sensors, performs data processing based on the input signal, and outputs the control signal over an injector 22 and ignition plug 24 grade based on the result of an operation. Furthermore, a control unit 60 controls the control parameter of others to which an internal combustion engine's operational status is changed.

[0034] Hereafter, each operation gestalt about control by the control unit 60 which aimed at balance between improvement in catalyst warming-up nature and reservation of brake performance is explained. Drawing 2 is a flow chart which shows the procedure of the brake control execution condition flag actuation routine concerning the 1st operation gestalt of this invention, and drawing 3 is a flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 1st operation gestalt. Both routines are performed a predetermined time period in a control unit 60.

[0035] In the brake control execution condition flag actuation routine of drawing 2 , first, it is step 102 and it is judged [of the ignition timing lag control for raising the warming-up nature of the catalytic converter 30 formed in the flueway 26 that exhaust gas should be purified] whether it is under activation. Since control which increases an inhalation air content according to the amount of lags in order that this catalyst warming-up lag control may carry out the lag of the ignition timing in order to raise the warming-up nature of the catalyst at the time between the colds as mentioned above, and it may maintain idle rpm is performed to coincidence, the absolute value of the negative pressure of the brake booster 32 may fall. If it is [lag control] under activation, while progressing to step 104, if it is not [lag control / be / it] under activation, it will progress to step 114.

[0036] Step 104 compares with a reference value P0 (for example, -26.6kPa (= -200mmHg)) the negative pressure PBK detected by the brake booster ** sensor 52, and it is PBK>P0. It is PBK<=P0 while progressing to step 106, when it is judged that it is insufficient at the time, i.e., negative pressure. When it is judged that it is enough at the time, i.e., negative pressure, it progresses to step 114.

[0037] At step 106, it is judged whether the signal BKSW from the brake switch 36 is ON, and when it is ON, while progressing to step 108, when it is OFF, it progresses to step 114. Step 108 compares with a reference value S0 (for example, 40 km/h) the vehicle speed SPD computed based on the output of a speed sensor 44, and it is SPD>S0. It is SPD<=S0 while sometimes progressing at step 110. Sometimes, it progresses to step 114.

[0038] At step 110, it is judged whether the idle-on flag EXIDL (when judged with it being in an idle state based on the output of the accelerator opening sensor 50, set as ON) is ON, and when it is ON, while progressing to step 112, when it is OFF, it progresses to step 114.

[0039] 1 is set to the brake control execution condition flag EXBK which shows that it is in the condition that engine control in consideration of brake performance should be performed at step 112 performed when all of the judgment result of steps 102, 104, 106, 108, and 110 are YES. At step 114 performed on the other hand when steps 102, 104, 106, and 108 or one judgment result of 110 serves as NO, since it is judged that it is in the condition that it is not necessary to perform engine control in consideration of brake performance, 0 is set to the brake control execution condition flag EXBK.

[0040] By the amount calculation routine of catalyst warming-up lags shown in drawing 3 , first, it is judged whether in step 152, the brake control execution condition flag EXBK is 1, and when it is EXBK=1, while progressing to step 154, this routine is ended at the time of EXBK=0.

[0041] At step 154, the throttle opening which attains demand negative pressure (for example, -39.9kPa (= -300mmHg)) under a current engine speed is computed. The map for asking for throttle opening from an engine speed and demand negative pressure for this calculation is beforehand stored in the memory in a control unit 60. And the throttle motor 17 is controlled by another control routine so that the opening of the throttle valve 16 detected by the throttle opening sensor 48 turns into computed throttle opening.

[0042] Subsequently, at step 156, an inhalation air content is presumed from the throttle opening computed at step 154. The map for calculating an inhalation air content from throttle opening for this presumption is beforehand stored in the memory in a control unit 60.

[0043] the inhalation air content presumed at step 156 in the last step 158, and the idle rotation maintenance torque (torque required to maintain idle rotation) currently searched for separately -- since -- the amount of catalyst warming-up lags is computed. The map which defined the amount of catalyst warming-up lags according to an inhalation air content and idle rotation maintenance torque for this calculation is beforehand stored in the memory in a control unit 60. This amount of catalyst warming-up lags is used as an amount of subtraction to the fundamental-points fire stage (value counted by the crank angle in the direction of a tooth lead angle from the compression top dead center (ignition advance angle)) determined from an engine speed and an engine load (for example, pressure-of-induction-pipe force detected by the intake-pressure sensor 46).

[0044] The engine performance of a booster in which inlet-pipe negative pressure was used is also fully securable with above-mentioned control, suppressing the fall of the engine

torque for catalyst warming up. In addition, in order to make possible the torque control at the time of transient operation by ignition timing, control (transient amendment idle lag control) which once carries out a lag setup of the ignition timing in an idle state may be performed, but since control which increases an inhalation air content also in this case according to the amount of lags in order to maintain idle rpm is performed to coincidence, the negative pressure of the brake booster 32 may fall. It is possible to apply the completely same control as the brake control to the above-mentioned catalyst warming-up lag control also to this transient amendment idle lag control. Moreover, the same is said of the operation gestalt explained below.

[0045] Next, the 2nd operation gestalt of this invention is explained. In the 2nd operation gestalt, while the same routine as the brake control execution condition flag actuation routine (drawing 2) in the 1st operation gestalt is performed, the amount calculation routine of catalyst warming-up lags shown in drawing 4 is performed. The contents of steps 252, 256, 258, and 260 in drawing 4 are the same as the contents of steps 152, 154, 156, and 158 in the amount calculation routine of catalyst warming-up lags concerning the 1st operation gestalt (drawing 3) respectively.

[0046] And to demand negative pressure having been made into constant value in the 1st operation gestalt, with the 2nd operation gestalt, ON time amount of the signal BKSW from the brake switch 36 is found, and the demand negative pressure according to the ON time amount is computed (step 254). The map as shown in drawing 5 (A) or (B) for this calculation is beforehand stored in the memory in a control unit 60. Since the negative pressure in a booster is greatly consumed so that ON time amount of BKSW is long, in these maps, it is set up so that ON time amount of BKSW is long, and demand negative pressure may become low. In this way, with the 2nd operation gestalt, it becomes possible to suppress the fall of an engine torque smaller as compared with the 1st operation gestalt.

[0047] Next, the 3rd operation gestalt of this invention is explained. Drawing 6 is a flow chart which shows the procedure of the brake control execution condition flag actuation routine concerning the 3rd operation gestalt, and drawing 7 is a flow chart which shows the procedure of the throttle opening calculation routine concerning the 3rd operation gestalt. The contents of steps 302, 304, 308, 310, 312, and 314 in drawing 6 are the same as the contents of steps 102, 104, 108, 110, 112, and 114 of the brake control execution condition flag actuation routine (drawing 2) concerning the 1st operation gestalt respectively.

[0048] On the other hand, at step 106 of drawing 2 , it is judged to it having been judged whether the signal BKSW from the brake switch 36 is ON by step 306 to which drawing 6 corresponds whether the time amount (namely, booster operating time) whose signal BKSW from the brake switch 36 is ON carried out fixed time amount progress. Therefore, according to the brake control execution condition flag actuation routine of drawing 6 , only when positive brakes operation is made, the brake control execution condition flag EXBK will be set to 1.

[0049] And by the throttle opening calculation routine of drawing 7 , while judging first

whether the brake control execution condition flag EXBK is 1 in step 352 and progressing to step 354 at the time of EXBK=1, this routine is ended at the time of EXBK=0. At step 354, while stopping activation of catalyst warming-up lag control, the usual demand ignition timing in the condition that catalyst warming-up lag control is not made is computed. Subsequently, the throttle opening which can realize idle rotation maintenance torque is set up, and a throttle valve 16 is controlled by step 356. When positive brakes operation is made in this way, idle rotation is maintained, while reservation of brake performance is thought as important and catalyst warming-up lag control is stopped.

[0050] Next, the 4th operation gestalt of this invention is explained. In the 4th operation gestalt, while the same routine as the brake control execution condition flag actuation routine (drawing 2) in the 1st operation gestalt is performed, the air-conditioner actuation routine shown in drawing 8 is performed. Where electric load of the internal combustion engine of air-conditioner 56 grade is turned ON, the inhalation air content is increasing from the off condition. Then, lack of negative pressure is made to cancel by suspending actuation of an air-conditioner 56 temporarily in this 4th operation gestalt.

[0051] That is, by the air-conditioner actuation routine of drawing 8 , while an air-conditioner 56 is operating in step 452, and judging whether the flag EXAC used as ON is ON and progressing to step 454 first at the time of EXAC=ON, this routine is ended at the time of EXAC=OFF. At step 454, while judging whether the brake control execution condition flag EXBK is 1 and progressing to step 456 at the time of EXBK=1, it progresses to step 458 at the time of EXBK=0. And while cutting an air-conditioner at step 456, actuation of an air-conditioner is returned at step 458. In addition, control with the same said of electric loads other than an air-conditioner is possible.

[0052] Next, the 5th operation gestalt which converted the above-mentioned 4th operation gestalt is explained. Even if it suspends actuation of an air-conditioner, when lack of negative pressure is not canceled, this 5th operation gestalt intends to perform the same control as the 1st operation gestalt as the further negative pressure recovery control, and there is. With the 5th operation gestalt, while the brake control execution condition flag actuation routine of drawing 2 is performed, the amount calculation routine of catalyst warming-up lags shown in drawing 9 is performed.

[0053] And the contents of steps 552, 554, 556, and 558 in drawing 9 are the same as the contents of steps 452, 454, 456, and 458 of the air-conditioner actuation routine (drawing 8) concerning the 4th operation gestalt respectively. And it is a reference value P0 about the negative pressure PBK detected by the brake booster ** sensor 52 at step 560 performed after the cut of the air-conditioner in step 556. It compares and is PBK>P0. It is PBK<=P0 while progressing after step 562, when it is judged at the time, i.e., negative pressure, that it is insufficient in addition. This routine is ended when it is judged that it recovered at the time, i.e., negative pressure. The contents of steps 562, 564, and 566 are the same as the contents of steps 154, 156, and 158 of the amount calculation routine of catalyst warming-up lags concerning the 1st operation gestalt (drawing 3) respectively.

[0054] Next, the 6th operation gestalt of this invention is explained. With this 6th

operation gestalt, the adjustable valve timing (VVT) device 58 is used. Drawing 10 is the valve timing diagram which expressed the closing motion stage of an intake valve and an exhaust air bulb according to the crank angle. While an exhaust air bulb is made to open with the valve-opening stage EVO of immobilization, it is made to close it with the clausilium stage EVC of immobilization, as shown in this drawing. On the other hand, although the valve-opening period is fixed about an intake valve, the valve-opening stage IVO and the clausilium stage IVC are adjustable, and can be most set as the timing which displaced only the amount of arbitration in both the directions of a tooth lead angle by making the closing motion stage by the side of a lag (IVOr and IVCr of this drawing) into a criteria location. and the valve timing from this criteria location -- a variation rate -- let an amount VTD be a controlled variable.

[0055] In the 6th operation gestalt, while the same routine as the brake control execution condition flag actuation routine (drawing 2) in the 1st operation gestalt is performed, the VVT device actuation routine shown in drawing 11 is performed. If the tooth lead angle of the inhalation-of-air valve timing is carried out, as a result of air's becoming generally that inhalation of air is easy to be carried out into a cylinder, the absolute value of inlet-pipe negative pressure increases. Then, lack of negative pressure is made to cancel in this 6th operation gestalt by carrying out the tooth lead angle of the inhalation-of-air valve timing.

[0056] namely, -- the VVT device actuation routine of drawing 11 -- first -- step 652 -- setting -- inhalation-of-air valve timing -- a variation rate -- while judging whether an amount VTD is 0 and progressing to step 654 at the time of VTD=0, this routine is ended at the time of VTD!=0. At step 654, while judging whether the brake control execution condition flag EXBK is 1 and progressing to step 656 at the time of EXBK=1, it progresses to step 658 at the time of EXBK=0. And while only a predetermined include angle carries out the tooth lead angle of the inhalation-of-air valve timing at step 656, at step 658, inhalation-of-air valve timing is returned to the maximum lag location.

[0057] Next, the 7th operation gestalt which converted the above-mentioned 6th operation gestalt is explained. Even if it carries out the tooth lead angle of the inhalation-of-air valve timing, when lack of negative pressure is not canceled, this 7th operation gestalt intends to perform the same control as the 1st operation gestalt as the further negative pressure recovery control, and there is. With the 7th operation gestalt, while the brake control execution condition flag actuation routine of drawing 2 is performed, the amount calculation routine of catalyst warming-up lags shown in drawing 12 is performed.

[0058] And the contents of steps 752, 754, 756, and 758 in drawing 12 are the same as the contents of steps 652, 654, 656, and 658 of the VVT device actuation routine (drawing 11) concerning the 6th operation gestalt respectively. And it is a reference value P0 about the negative pressure PBK detected by the brake booster ** sensor 52 at step 760 performed after tooth-lead-angle actuation of the inhalation-of-air valve timing in step 756. It compares and is PBK>P0. It is PBK<=P0 while progressing after step 762, when it is judged at the time, i.e., negative pressure, that it is insufficient in addition. This routine is ended when it is judged that it recovered at the time, i.e., negative pressure. The contents

of steps 762, 764, and 766 are the same as the contents of steps 154, 156, and 158 of the amount calculation routine of catalyst warming-up lags concerning the 1st operation gestalt (drawing 3) respectively.

[0059] Next, the 8th operation gestalt of this invention is explained. In the 8th operation gestalt, while the same routine as the brake control execution condition flag actuation routine (drawing 2) in the 1st operation gestalt is performed, the change gear actuation routine shown in drawing 13 is performed. Generally a rotational frequency can be raised by what a change gear is changed to a low-speed stage side for (down shift), and the absolute value of negative pressure can be increased. Then, in this 8th operation gestalt, a change gear 42 is used and the insufficient dissolution of negative pressure is achieved by the down shift.

[0060] That is, by the change gear actuation routine of drawing 13 , while judging first whether a change gear is in gear ratios other than the 1st speed in step 852 and progressing to step 854 at the times other than the 1st speed, this routine is ended at the time of the 1st speed. At step 854, while judging whether the brake control execution condition flag EXBK is 1 and progressing to step 856 at the time of EXBK=1, it progresses to step 858 at the time of EXBK=0. And while carrying out a down shift at step 856, at step 858, a change gear is returned to a normal state.

[0061] Next, the 9th operation gestalt which converted the above-mentioned 8th operation gestalt is explained. Even if it carries out a down shift, when lack of negative pressure is not canceled, this 8th operation gestalt intends to perform the same control as the 1st operation gestalt as the further negative pressure recovery control, and there is. With the 9th operation gestalt, while the brake control execution condition flag actuation routine of drawing 2 is performed, the amount calculation routine of catalyst warming-up lags shown in drawing 14 is performed.

[0062] And the contents of steps 952, 954, 956, and 958 in drawing 14 are the same as the contents of steps 852, 854, 856, and 858 of the change gear actuation routine (drawing 13) concerning the 8th operation gestalt respectively. And it is a reference value P0 about the negative pressure PBK detected by the brake booster ** sensor 52 at step 960 performed after operation of the down shift in step 856. It compares and is PBK>P0. It is PBK<=P0 while progressing after step 962, when it is judged at the time, i.e., negative pressure, that it is insufficient in addition. This routine is ended when it is judged that it recovered at the time, i.e., negative pressure. The contents of steps 962, 964, and 966 are the same as the contents of steps 152, 154, 156, and 158 of the amount calculation routine of catalyst warming-up lags concerning the 1st operation gestalt (drawing 3) respectively.

[0063] Next, the 10th operation gestalt of this invention is explained. Drawing 15 is a flow chart which shows the procedure of the brake control execution condition flag actuation routine concerning the 10th operation gestalt, and drawing 16 is a flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 10th operation gestalt. The contents of steps 1002, 1004, 1006, 1008, 1010, and 1012 in drawing 15 are the same as the contents of steps 102, 104, 108, 110, 112, and 114 of the

brake control execution condition flag actuation routine (drawing 2) concerning the 1st operation gestalt respectively. Moreover, the contents of steps 1052, 1056, 1058, and 1060 in drawing 16 are the same as the contents of steps 152, 154, 156, and 158 of the amount calculation routine of catalyst warming-up lags concerning the 1st operation gestalt (drawing 3) respectively.

[0064] That is, while the step (step 106 of drawing 2) which judges whether the signal BKSW from the brake switch 36 is ON is deleted as compared with the 1st operation gestalt, step 1054 (drawing 16) is added. At this step 1054, while the brake sensor 54 detects the amount of brake treading in (namely, travel of a booster), it breaks in from the temporal response of that amount of treading in, and a rate (namely, actuation rate of a booster) is computed. And by referring to the **** map which was beforehand stored in the memory in a control unit 60 and which is shown in drawing 17 , it breaks in with the amount of brake treading in, and the demand negative pressure according to a rate is computed. In this way, with this 10th operation gestalt, improvement in the calculation precision of demand negative pressure is achieved.

[0065] Next, the 11th operation gestalt of this invention is explained. When target damping force and realizable damping force are searched for and realizable damping force is less than target damping force, by decreasing the amount of catalyst warming-up lags, and decreasing the throttle opening for realizing idle rotation maintenance torque at that time, this 11th operation gestalt will raise the absolute value of negative pressure, and will raise damping force. The flow chart which shows the procedure of the target damping force calculation which drawing 18 requires for the 11th operation gestalt, and a realizable damping force presumption routine, and drawing 19 are maps referred to by processing of drawing 18 , and the map for breaking in with the amount of brake treading in, and searching for target damping force from a rate and drawing 20 show the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 11th operation gestalt, respectively.

[0066] It is a reference value S0 about the vehicle speed SPD first computed in step 1102 based on the output of a speed sensor 44 by target damping force calculation of drawing 18 , and the realizable damping force presumption routine. It compares and is SPD>S0. It is SPD<=S0 while sometimes progressing at step 1104. Sometimes, this routine is ended. At step 1104, when it is ON, while judging whether the idle-on flag EXIDL is ON, and progressing to step 1106, when it is OFF, this routine is ended.

[0067] At step 1106, while the brake sensor 54 detects the amount of brake treading in, by breaking in from the temporal response of the amount of treading in, and computing a rate, by referring to the **** map which was beforehand stored in the memory in a control unit 60 and which is shown in drawing 19 , it breaks in with the amount of brake treading in, and the target damping force TTBKP according to a rate is computed. Subsequently, at step 1108, the realizable damping force TBKP is computed based on the negative pressure PBK detected by the brake booster ** sensor 52. The map for searching for the realizable damping force TBKP from negative pressure PBK for this calculation is beforehand stored

in the memory in a control unit 60.

[0068] Subsequently, by the amount calculation routine of catalyst warming-up lags of drawing 20 , while measuring the target damping force TTBKP and the realizable damping force TBKP and progressing to step 1154 in step 1152 first at the time of TTBKP>TBKP, this routine is ended at the time of TTBKP<=TBKP. At step 1154, demand negative pressure is computed from the deflection of TTBKP and TBKP. The map for asking for demand negative pressure from that deflection for this calculation is beforehand stored in the memory in a control unit 60. The contents of the subsequent steps 1156, 1158, and 1160 are the same as the contents of steps 154, 156, and 158 of the amount calculation routine of catalyst warming-up lags concerning the 1st operation gestalt (drawing 3) respectively.

[0069] In addition, it may replace with the routine of drawing 20 and you may make it the amount calculation routine of catalyst warming-up lags as shown in drawing 21 . By this routine, the deflection DTBKP of the target damping force TTBKP and the realizable damping force TBKP is computed (step 1184), and the amount of catalyst warming-up lags is directly computed from this deflection DTBKP (step 1186). In addition, the map for calculating the amount of catalyst warming-up lags from deflection DTBKP for this calculation is beforehand stored in the memory in a control unit 60.

[0070] Next, the 12th operation gestalt of this invention is explained. When target damping force and real damping force are searched for and real damping force is less than target damping force, by decreasing the amount of catalyst warming-up lags, and decreasing the throttle opening for realizing idle rotation maintenance torque at that time, this 12th operation gestalt will raise the absolute value of negative pressure, and will raise damping force. The flow chart which shows the procedure of the target damping force calculation which drawing 22 requires for the 12th operation gestalt, and a real damping force presumption routine, and drawing 23 are maps referred to by processing of drawing 22 , and the map for searching for real damping force from deceleration and drawing 24 show the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 12th operation gestalt, respectively.

[0071] The contents of steps 1202, 1204, and 1206 in target damping force calculation of drawing 22 and a real damping force presumption routine are the same as the contents of steps 1102, 1104, and 1106 in drawing 18 mentioned above respectively. At step 1208, the real damping force TBKPN according to deceleration is computed by computing deceleration from the temporal response of the vehicle speed detected by the speed sensor 44, and referring to the **** map which was beforehand stored in the memory in a control unit 60 and which is shown in drawing 23 . Moreover, the amount calculation routine of catalyst warming-up lags of drawing 24 transposes the realizable damping force TBKP in it to the real damping force TBKPN to the routine of drawing 20 mentioned above.

[0072] In addition, it may replace with the routine of drawing 24 and you may make it the amount calculation routine of catalyst warming-up lags as shown in drawing 25 . By this routine, the deflection DTBKPN of the target damping force TTBKP and the real damping

force TBKPN is computed (step 1284), and the amount of catalyst warming-up lags is directly computed from this deflection DTBKPN (step 1286). In addition, the map for calculating the amount of catalyst warming-up lags from deflection DTBKPN for this calculation is beforehand stored in the memory in a control unit 60.

[0073] Next, the 13th operation gestalt of this invention is explained. This 13th operation gestalt converts the 11th operation gestalt mentioned above, and is changed into step 1308 step 1108 of the target damping force calculation concerning the 11th operation gestalt and a realizable damping force presumption routine (drawing 18) is indicated to be to drawing 26 . That is, in addition to the negative pressure PBK detected by the brake booster ** sensor 52, at step 1308, the realizable damping force TBKP is computed also based on driving torque.

[0074] The manipulation routine for calculation of this driving torque is shown in the flow chart of drawing 27 . By this routine, engine illustration torque is first computed in step 1302 from a real air content, ignition timing, and an air-fuel ratio (A/F). Subsequently, at step 1304, engine output-shaft torque is computed by subtracting auxiliary machinery loss, a pumping loss, and mechanical loss from engine illustration torque. And at the last step 1306, driving torque is computed from engine output-shaft torque, a torque ratio, a change gear ratio, and a drive-system transmission efficiency. In this way, by computing the realizable damping force TBKP also in consideration of the computed driving torque, improvement in the calculation precision of the realizable damping force TBKP is achieved.

[0075] By the way, when the brake booster ** sensor 52 and the brake sensor 54 are out of order, even if it carries out above-mentioned control, desired effectiveness cannot be acquired, but there is a possibility of having a bad influence on the contrary. Then, it is desirable to enable it to detect failure of this sensor system. The sensor system exception-processing routine shown in drawing 28 is performed periodically there.

[0076] First, at step 1402, a fixed time amount monitor of the pressure PBK which the pressure-of-induction-pipe force PM which the output of the intake-pressure sensor 46 shows, and the output of the brake booster ** sensor 52 show is carried out. And at step 1404, when abnormalities are not accepted when PBK takes the unusual value which is hard to assume, in view of the value of PM while considering that abnormalities are in the brake booster ** sensor 52 and progressing to step 1410 especially, it progresses to step 1406.

[0077] At step 1406, a fixed time amount monitor of the change of the amount of brake treading in which change of PBK and the output of the brake sensor 54 show is carried out. And at step 1408, when abnormalities are not accepted when change of the amount of treading in is accepted not to support change of PBK while considering that abnormalities are in the brake sensor 54 and progressing to step 1410 especially, this routine is ended. At step 1410, the measures which forbid activation of catalyst warming-up lag control are taken, and control of an inhalation air content and ignition timing is returned to the usual control.

[0078] As mentioned above, although the described operation gestalt is related with a port

injection type engine, in the lean-burn engine of the direct injection method in a cylinder, Lean control may be carried out a sake [on a catalyst warming-up disposition]. Also in such a case, too, the absolute value of inlet-pipe negative pressure may fall, and brake performance may fall. So, in a lean-burn engine, negative pressure can be recovered by stopping the Lean control.

[0079]

[Effect of the Invention] As explained above, according to this invention, control which aimed at balance between improvement in catalyst warming-up nature and reservation of brake performance is realized.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the internal combustion engine whole schematic diagram equipped with the control unit concerning this invention.

[Drawing 2] It is the flow chart which shows the procedure of the brake control execution condition flag actuation routine concerning the 1st operation gestalt of this invention.

[Drawing 3] It is the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 1st operation gestalt.

[Drawing 4] It is the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 2nd operation gestalt of this invention.

[Drawing 5] (A) And it is drawing in which (B) shows the map for asking for demand negative pressure from brake switch-on time amount.

[Drawing 6] It is the flow chart which shows the procedure of the brake control execution condition flag actuation routine concerning the 3rd operation gestalt of this invention.

[Drawing 7] It is the flow chart which shows the procedure of the throttle opening calculation routine concerning the 3rd operation gestalt.

[Drawing 8] It is the flow chart which shows the procedure of the air-conditioner actuation routine concerning the 4th operation gestalt of this invention.

[Drawing 9] It is the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 5th operation gestalt of this invention.

[Drawing 10] It is the valve timing diagram which expressed the closing motion stage of an intake valve and an exhaust air bulb according to the crank angle.

[Drawing 11] It is the flow chart which shows the procedure of the VVT device actuation routine concerning the 6th operation gestalt of this invention.

[Drawing 12] It is the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 7th operation gestalt of this invention.

[Drawing 13] It is the flow chart which shows the procedure of the change gear actuation routine concerning the 8th operation gestalt of this invention.

[Drawing 14] It is the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 9th operation gestalt of this invention.

[Drawing 15] It is the flow chart which shows the procedure of the brake control execution condition flag actuation routine concerning the 10th operation gestalt of this invention.
[Drawing 16] It is the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 10th operation gestalt.
[Drawing 17] It is drawing showing the map for breaking in with the amount of brake treading in, and computing demand negative pressure from a rate.
[Drawing 18] It is the flow chart which shows the procedure of the target damping force calculation concerning the 11th operation gestalt of this invention, and a realizable damping force presumption routine.
[Drawing 19] It is drawing showing the map for breaking in with the amount of brake treading in, and searching for target damping force from a rate.
[Drawing 20] It is the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 11th operation gestalt.
[Drawing 21] It is the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the modification of the 11th operation gestalt.
[Drawing 22] It is the flow chart which shows the procedure of the target damping force calculation concerning the 12th operation gestalt of this invention, and a real damping force presumption routine.
[Drawing 23] It is drawing showing the map for searching for real damping force from deceleration.
[Drawing 24] It is the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the 12th operation gestalt.
[Drawing 25] It is the flow chart which shows the procedure of the amount calculation routine of catalyst warming-up lags concerning the modification of the 12th operation gestalt.
[Drawing 26] It is the flow chart which shows the procedure of the target damping force calculation concerning the 13th operation gestalt of this invention, and a realizable damping force presumption routine.
[Drawing 27] It is the flow chart which shows the procedure of a driving torque calculation routine.
[Drawing 28] It is the flow chart which shows the procedure of a sensor system exception-processing routine.
[Description of Notations]
10 -- Engine
12 -- Inhalation-of-air path
14 -- Air cleaner
16 -- Throttle valve
17 -- Throttle motor
18 -- Surge tank
20 -- Inlet manifold

22 -- Injector
24 -- Ignition plug
26 -- Flueway
28 -- Exhaust manifold
30 -- Catalytic converter
32 -- Brake booster
34 -- Brake pedal
36 -- Brake switch
38 -- Stop lamp
40 -- Crank angle sensor
42 -- Change gear (transmission)
44 -- Speed sensor
46 -- Intake-pressure sensor
48 -- Throttle opening sensor
50 -- Accelerator opening sensor
52 -- Brake booster ** sensor
54 -- Brake sensor
56 -- Air-conditioner (air conditioner)
58 -- Adjustable valve timing (VVT) device
60 -- Control unit